

The military is working hard to understand the noise environments at installations throughout the world. Acoustical engineers and researchers have been studying military equipment and training to better understand how military sound travels and by what means it can be minimized. This fact sheet presents some of their findings.

How is noise mitigated?

What is mitigation?

“To mitigate” means “to make less severe or painful.” Mitigation projects often require help from an expert in military acoustics. However, with some basic knowledge about how noise travels, installation personnel can significantly mitigate the noise impacts from their installation’s activities.

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Mitigation at the Source

Mitigation at the source reduces the amount of noise emitted by an operation or piece of equipment. The following is a list of some mitigation techniques that have been used with varying success.

- Reducing the number of operations
- Quieter fixed-wing and rotary-wing (helicopters and tilt-rotor) aircraft
- Acoustic directivity—Every weapon has a characteristic noise field called “acoustic directivity.” For example, a 2.75-inch rocket and light assault weapon (LAW) make the most noise to the rear of the firing point. A rifle or tank gun makes the most noise in front of the firing point. Sometimes, knowledge of acoustic directivity can be used to reduce the source noise in a particular direction.
- Type of round
- Burial of charges

- Foam cover
- Firing through foam
- Silencers for small arms
- Complete Aircraft hush houses
- Aircraft engine test cells
- Vehicle mufflers
- Noise cancellation technology
- Fly Neighborly—this manual published by the Helicopter Association International provides guidance on how to fly helicopters to make the least amount of noise.

Mitigation along the Path

Mitigation along the path reduces the amount of noise getting through to the receiver. The following is a list of some mitigation techniques that have been used with varying success.

- Barriers for traffic
- Barriers for small arms
- Using ground impedance—Sound propagating close to the ground or reflecting from the ground can lose some of its energy into the ground. Sound propagates better over “hard” ground than over “soft” ground.
- Distance/altitude
- Using wind effects—It is better to locate a small arms range or grenade range downwind of a noise-sensitive area than upwind. This rule-of-thumb does not work beyond 5 kilometers for heavy weapons, since a surface wind in one direction may be overlain at a higher altitude by a wind in the opposite direction.
- Avoiding water—Low-frequency sound propagates efficiently over the surface of a lake or still sea. Demolitions and heavy weapons are

low-frequency sound sources. Given a choice, these sources should be kept away from a body of water if there are houses on the other side.

- **Using weather conditions**—Sometimes avoiding noise problems can be as simple as checking the weather. Temperature, wind speed and direction, and humidity can affect how sound travels. Studies have found that artillery firing, for example, can be inaudible at one time and extremely loud at another time depending on variations in temperature and wind speed. Rescheduling a certain exercise may not be necessary if weather conditions would lessen the noise to the point where annoyance would not result.

Mitigation at the Receiver

Mitigation at the Receiver may involve architectural controls or some other means of reducing psychological annoyance. The following is a list of some mitigation techniques that have been used with varying success.

- **Architectural Controls**
 - Insulating homes against outdoor noise
 - Acoustical windows and doors
 - Rattle-proofing homes
- **Psychological Measures**
 - Spacing between events—There is reason to believe that concentrating aircraft operations and weapons firing during a shorter period can reduce annoyance
 - Time of day
 - Advance notice

Good and bad atmospheric conditions

“Good” Conditions	“Bad” Conditions
Clear skies with billowy cloud formations, especially during warm periods of the year	Days of steady winds of 5–10 mph with gusts of greater velocities (above 20 mph) in the direction of residences close by
A rising barometer immediately following a storm	Clear days on which “layering” of smoke or fog are observed
	Cold hazy or foggy mornings
	Days following a day when large extremes of temperature (about 36°F) between day and night are noted
	Generally high barometer readings with low temperatures

A variety of measures can mitigate noise impacts on neighboring communities. Selecting the appropriate mitigation measures requires an understanding of the real problem, exactly how people are being impacted. Understanding the true basis for annoyance can help avoid useless mitigation.

For more information about the Army’s noise management program contact:

Operational Noise Program
U.S. Army Center for Health Promotion and Preventive Medicine
MCHB-TS-EON
Aberdeen Proving Ground, MD 21010-5403
410-436-3829
<http://chppm-www.apgea.army.mil/dehe/morenoise//>

For more information on the Navy’s Noise Management Program contact:

Special Assistant for AICUZ and Encroachment
Commander Navy Installations
Naval Facilities Engineering Command
Washington Navy Yard, Washington DC 20374
202-685-9181

For more information on the Air Force's Noise Management Program contact:

AICUZ/Noise Program Manager
Bases and Units Branch
HQ USAF/ILEPB
1260 Air Force Pentagon
Washington, D.C. 20330.
703-604-5277

For more information on the Marine Corp's Noise Management Program contact:

Community and Land Use Planner for AICUZ
Headquarter Marine Corps
Washington DC, 20380-1775
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